

R10, R16, R2
R11, R17, R22



LM193/LM293/LM393, LM2903 Low Power Low Offset Voltage Dual Comparators

General Description

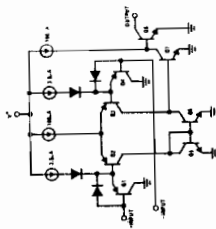
The LM193 series consists of two independent precision voltage comparators with an offset voltage specification as low as 2.0 mV max for two comparators which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground, even though operated from a single power supply voltage.

Application areas include limit comparators, simple analog to digital converters, pulse synchronizers, relay drivers, error detectors, wide range VCO's, RS flip-flops, multivibrators and high voltage digital logic. The LM193 series was designed to interface with TTL and CMOS. When interfaced from both plus and minus power supplies, the LM193 series will directly interface with MCS logic where their low power drain is a distinct advantage over standard comparators.

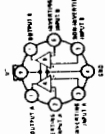
Advantages

- High precision comparators
- Reduced VOS drift over temperature

Schematic and Connection Diagrams



Metal Can Package



Dual-In-Line Package

Order Number LM193H,
LM193H/883,
LM193AH, LM192AH/883,
LM293AH, LM292AH/883,
LM293AH or LM393AH
See NS Package Number H08C

Order Number LM193J/883,
LM193AJ/883,
LM393J, LM393AJ/883,
LM393M, LM293M/883,
LM293M or LM393M
See NS Package Number J08A,
M08A or N08E

*Also available per J43510/11202

- Eliminates need for dual supplies
- Allows sensing near ground
- Compatible with all forms of logic
- Power drain suitable for battery operation

Features

- Wide supply voltage range
2.0 Vcc to 36 Vcc
single or dual supplies
 ± 1.0 Vcc to ± 18 Vcc
- Very low supply current drain (0.4 mA) — independent of supply voltage
- Low input biasing current
25 nA
- Low input offset current
 ± 5 nA
- Low input offset voltage
 ± 3 mV
- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- Low output saturation voltage,
250 mV at 4 mA
- Output voltage compatible with TTL, DTL, ECL,
MOS and CMOS logic systems

Application Hints

The LM193 series are high gain, wide bandwidth devices which, like most comparators, can easily compensate if the output lead is inadvertently allowed to become inductively couple to the inputs via stray capacitance. This shows up only during the output voltage transition. Power supply bypassing is not required to solve this problem. Standard PC board layout is helpful as it reduces stray input-output coupling. Reducing the input resistors to $< 10 \text{ k}\Omega$ reduces the feedback signal levels and, finally, adding even a small amount (1.0 to 10 mV) of positive feedback (hysteresis) causes such a rapid transition that oscillations due to stray feedback are not possible. Simply socketing the IC and attaching resistors to the pins will cause input-output oscillations during the small transition intervals unless hysteresis is used. If the input signal is a pulse waveform, with relatively fast rise and fall times, hysteresis is not required.

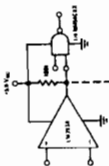
All pins of any unused comparators should be grounded. The bias network of the LM193 series establishes a drain current which is independent of the magnitude of the power supply voltage over the range of from 2.0 Vdc to 30 Vdc. It is usually unnecessary to use a bypass capacitor across the power supply line.

Typical Applications ($V^+ = 5.0 \text{ Vdc}$)

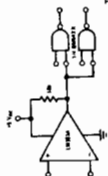
Basic Comparator



Driving CMOS

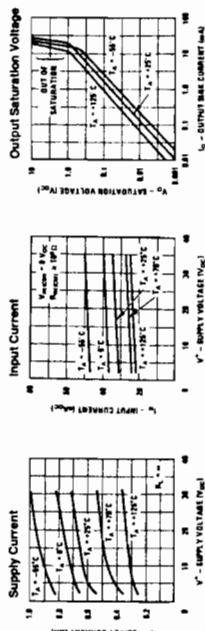


Driving TTL

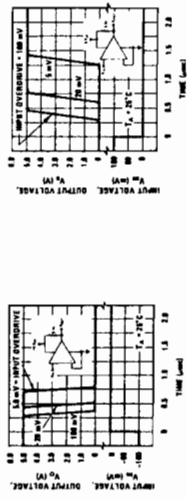


TLN-5706-2

Typical Performance Characteristics LM193/LM293/LM393, LM193A/LM293A/LM393A

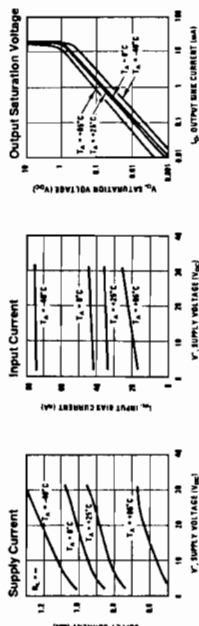


Response Time for Various Input Overdrives—Positive Transition

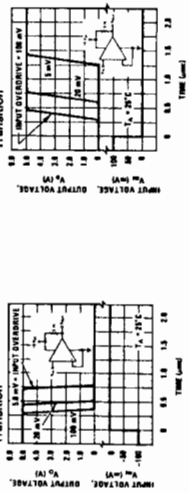


TLN-5706-3

Typical Performance Characteristics LM2903



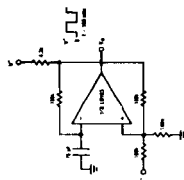
Response Time for Various Input Overdrives—Positive Transition



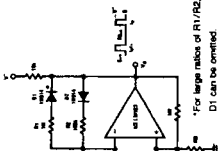
TLN-5706-4

Typical Applications (Continued)

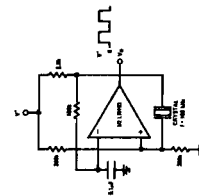
Squarewave Oscillator



Pulse Generator

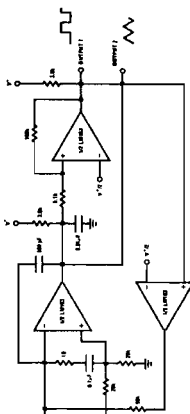


Crystal Controlled Oscillator



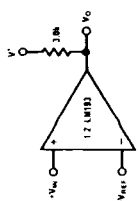
*For large values of $R1/R2$, $D1$ can be omitted.

Two-Decade High-Frequency VCO

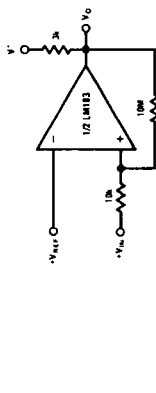


$V_{CC} = -5V$, $V_{EE} = +5V$
 $+250mV \leq V_{CC} \leq +50V$
 $700Hz \leq f \leq 100kHz$

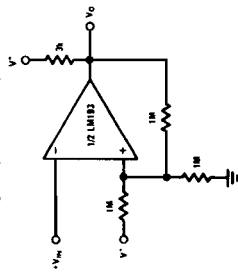
Basic Comparator



Non-Inverting Comparator with Hysteresis

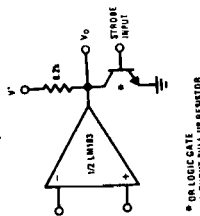


Inverting Comparator with Hysteresis

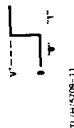


Typical Applications (Continued)

Output Strobe

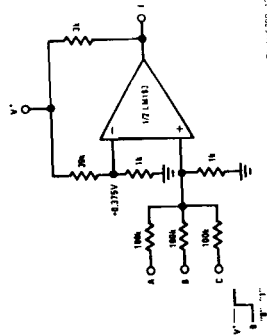


*OR LOGIC GATE
 WITHOUT PULL-UP RESISTOR



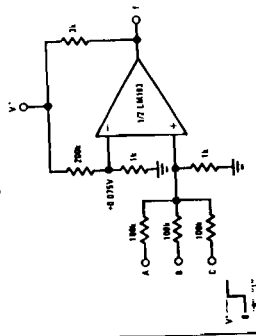
TLH45708-11

AND Gate



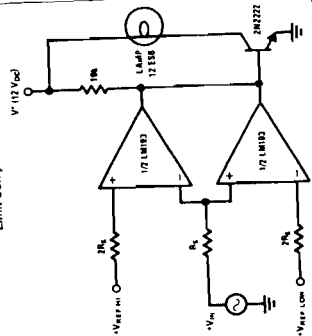
TLH45708-12

OR Gate

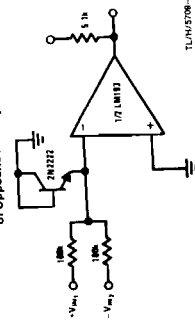


TLH45708-13

Limit Comparator



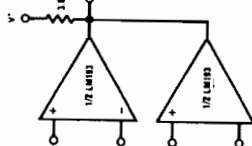
TLH45708-14

Comparing Input Voltages
of Opposite Polarity

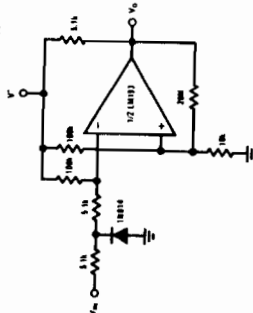
TLH45708-15

Typical Applications (Continued)

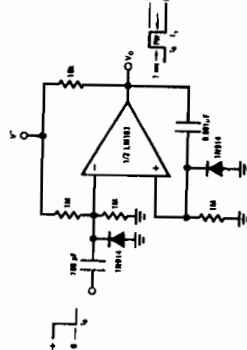
Oring the Outputs



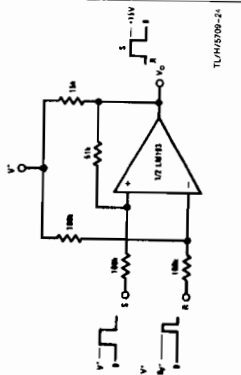
Zero Crossing Detector (Single Power Supply)



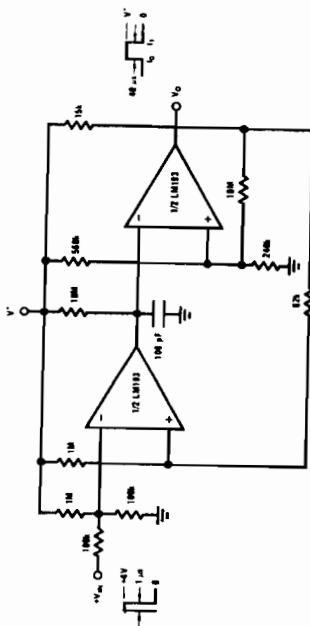
One-Shot Multivibrator



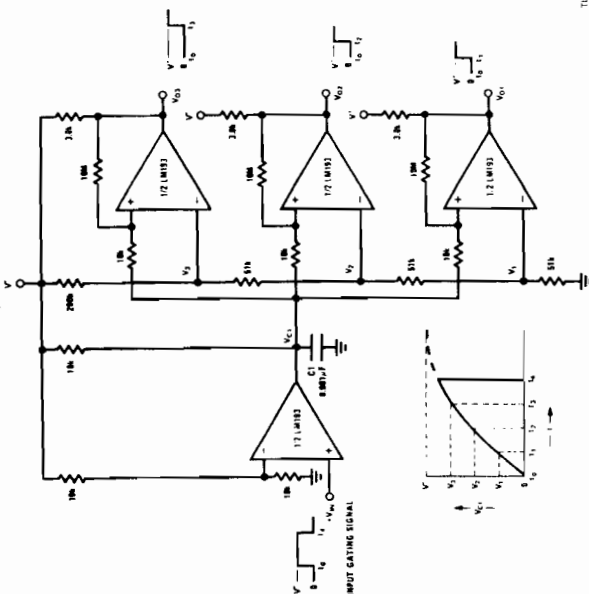
Bi-Stable Multivibrator



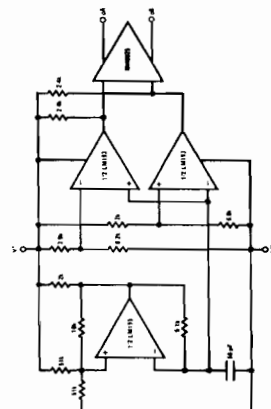
One-Shot Multivibrator with Input Lock Out

Typical Applications (Continued) ($V^+ = V_{CC}$)

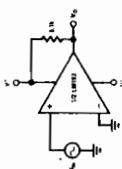
Time Delay Generator

Split-Supply Applications ($V^+ = +15V_{CC}$ and $V^- = -15V_{CC}$)

MOS Clock Driver



Zero Crossing Detector



Comparator With a Negative Reference

